AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions, and listings, of claims in the application.

Listing of Claims:

1. (Twice Amended) An eddy current device for non-destructive evaluation of an electrically conductive material, comprising:

an excitation coil for inducing eddy currents within the electrically conductive material, the excitation coil having windings wherein the excitation coil's longitudinal axis is perpendicular to the surface of the electrically conductive material;

a giant magnetoresistive sensor having a longitudinal axis perpendicular to the surface of the electrically conductive material and surrounded by the windings of the excitation coil;

a tubular flux focusing lens disposed between the excitation coil and the giant magnetoresistive sensor, composed of a conductive material having a high magnetic permeability, having a first opening opposite the surface of the electrically conductive material and having a second opening adjacent to the surface of the electrically conductive material and which prevents magnetic coupling between the excitation coil and the giant magnetoresistive sensor and which produces high flux density at the outer edge of the giant magnetoresistive sensor; ~~and~~

<u>a feedback source; and</u>

a feedback coil <u>electrically connected to the feedback source and</u> positioned adjacent to the giant magnetoresistive sensor along the longitudinal axis thereof and surrounded by the windings of the excitation coil and the flux focusing lens<u>, the feedback coil receiving a feedback current from the feedback source having the same frequency as the excitation coil frequency but 180 degrees out of phase with the output of the giant magnetoresistive sensor, such that leakage magnetic fields are canceled.</u>

2. (Original) The eddy current device as recited in claim 1, wherein the windings of the excitation and feedback coils are substantially circular.

3. (Original) The eddy current device as recited in claim 2, wherein the excitation coil is substantially concentrically disposed around the giant magnetoresistive sensor and the feedback coil.

4. (Original) An eddy current device as recited in claim 1, additionally comprising means for applying a drive current to the windings of the excitation coil, wherein the frequency is dependent on the desired depth of flaw detection.

5. (Canceled)

6. (Original) An eddy current device as recited in claim 1, additionally comprising biasing means for biasing the giant magnetoresistive sensor in its linear region.

7. (Original) The eddy current device as recited in claim 6, wherein the biasing means is a D.C. voltage applied to the feedback coil.

8. (Original) The eddy current device as recited in claim 6, wherein the biasing means is a permanent magnet positioned adjacent to the giant magnetoresistive sensor.

9. (Previously Canceled)

10. (Original) The eddy current device as recited in claim 1, further comprising:

an amplifying means for amplifying the output of the giant magnetoresistive sensor; and

a detection means for registering the output of the amplifying means.

11. (Original) The eddy current device as recited in claim 10, wherein the amplifying means is a differential preamplifier.

12. (Original) The eddy current device as recited in claim 10, wherein the detection means is an A.C. voltmeter.

13. (Original) The eddy current device as recited in claim 1, wherein the giant magnetoresistive sensor is a packaged eight pin integrated chip.

14. (Original) The eddy current device as recited in claim 1, wherein the giant magnetoresistive sensor is in its die form.

15. (Previously Amended) An eddy current device as recited in claim 4, wherein the thickness of the flux focusing lens is at least three skin depths of a magnetic flux generated by the drive current applied to the excitation coil.

16. (Original) The eddy current device as recited in claim 3, wherein the flux focusing lens is substantially cylindrical and the excitation coil is concentrically disposed around the flux focusing lens.

17. (Original) The eddy current device as recited in claim 1, wherein the height of the giant magnetoresistive sensor is less than the half height of the flux focusing lens.

18. (Original) The eddy current device as recited in claim 1, wherein the height of the giant magnetoresistive sensor is less than one half the height of the excitation coil.

19. (Original) The eddy current device as recited in claim 1, wherein the bottom edge of the giant magnetoresistive sensor is co-planar with the bottom edge of the excitation coil and the second opening of the flux focusing lens.

20. (Currently Amended) An eddy current device resistant to conductive material edge effects for non-destructive evaluation of an electrically conductive material comprising:

an excitation coil for inducing eddy currents within the electrically conductive material, the excitation coil having windings wherein the excitation coil's longitudinal axis is perpendicular to the surface of the electrically conductive material;

a giant magnetoresistive sensor having a longitudinal axis perpendicular to the surface of the electrically conductive sample and surrounded by the windings of the excitation coil;

a tubular flux focusing lens disposed between the excitation coil and the giant magnetoresistive sensor, composed of a conductive material having a high magnetic permeability, having a first opening opposite the surface of the electrically conductive material and having a second opening adjacent to the surface of the electrically conductive material and which prevents magnetic coupling between the excitation coil and the giant magnetoresistive sensor and which produces high flux density at the outer edge of the giant magnetoresistive sensor;

<u>a feedback source;</u>

a feedback coil <u>electrically connected to the feedback source and</u> positioned adjacent to the giant magnetoresistive sensor along the longitudinal axis thereof and surrounded by the windings of the excitation coil and the flux focusing lens<u>, the feedback coil receiving a feedback current from the feedback source having the same frequency as the excitation coil frequency but 180 degrees out of phase with the output of the giant magnetoresistive sensor, such that leakage magnetic fields are canceled</u>; and

a flux focusing shield which surrounds the excitation coil.

21. (Original) An eddy current device resistant to conductive material edge effects as recited in claim 20, wherein the flux focusing shield is composed of a conducting material of high magnetic permeability.

22. (Original) An eddy current device highly resistant to lift off conditions for non-destructive evaluation of electrically conductive material comprising a plurality of giant magnetoresistive flux focusing eddy current probes, and additionally comprising a casing.

23. (Currently Amended) An eddy current device highly resistant to lift off conditions for non-destructive evaluation of electrically conductive material comprising:

an excitation coil for inducing eddy currents within a conducting material, the excitation coil having windings wherein the excitation coil's longitudinal axis is perpendicular to the conducting material;

a plurality of giant magnetoresistive sensors, each surrounded by the windings of the excitation coil;

a plurality of feedback coils <u>for canceling leakage magnetic fields,</u> each adjacent to, electrically connected to and positioned along the longitudinal axis of a corresponding giant magnetoresistive sensor and surrounded by the windings of the excitation coil; and

a flux focusing lens, having an opening at opposite ends of its longitudinal axis, which magnetically separates the excitation coil and the giant magnetoresistive sensors and which produces high flux density.

24. (Original) The eddy current device as recited in claim 1, further comprising processing means for processing the giant magnetoresistive sensor output.

25. (Original) The eddy current device as recited in claim 24, wherein the processing means comprises data analysis obtaining a phase rotated amplitude, flattening the phase rotated amplitude and applying a low pass two-dimensional Fourier filter.

26. (Currently Amended) A magnetoresistive flux focusing eddy current device for non-destructive evaluation of an electrically conductive material surrounding a circular inhomogeneity, comprising:

an excitation coil for inducing eddy currents within the electrically conductive material, the excitation coil having windings wherein the excitation coil's longitudinal axis is perpendicular to the surface of the electrically conductive material;

a giant magnetoresistive sensor having a longitudinal axis perpendicular to the surface of the electrically conductive sample and surrounded by the windings of the excitation coil;

a tubular flux focusing lens disposed between the excitation coil and the giant magnetoresistive sensor, composed of a conductive material having a high magnetic permeability, having a first opening opposite the surface of the electrically conductive material and having a second opening adjacent to the surface of the electrically conductive material and which prevents magnetic coupling between the excitation coil and the giant magnetoresistive sensor and which produces high flux density at the outer edge of the giant magnetoresistive sensor;

a feedback source;

a feedback coil electrically connected to the feedback source and positioned adjacent to the giant magnetoresistive sensor along the longitudinal axis thereof and surrounded by the windings of the excitation coil and the flux focusing lens, the feedback cool receiving a feedback current from the feedback source having the same frequency as the excitation coil frequency but 180 degrees out of phase with the output of the giant magnetoresistive sensor, such that leakage magnetic fields are canceled ; and

rotator means for rotating the device about the circular inhomogeneity such that the center of the device remains a constant distance from the center of the circular inhomogeneity.

27. (Original) The eddy current device of claim 26, further comprising:

an amplifying means for amplifying the output of the giant magnetoresistive sensor;

a detection means for registering the output of the amplifying means;

monitoring means for monitoring the output of the giant magnetoresistive sensor; and

scanning means for scanning the device about the circumference of the circular inhomogeneity.

28. (Original) The eddy current device as recited in claim 27, wherein the amplifying means is a differential amplifier.

29. (Original) The eddy current device as recited in claim 27, wherein the detection means is a peak to peak detector.

30. (Original) The eddy current device as recited in claim 27, wherein the monitoring means is a computer.

31. (Original) The eddy current device as recited in claim 27, wherein the scanning means is a stepper motor.

32. (Original) The eddy current device as recited in claim 27, wherein the detection means comprises amplified low pass filtering of an amplitude modulated notch-filtered giant magnetoresistive sensor signal.

33. (Currently Amended) An eddy current device as recited in claim 26, additionally comprising means for applying a drive current to the windings of the excitation coil, wherein the frequency is dependent on the desired depth of flaw detection~~, and means for applying a feedback current to the windings of the feedback coil, the feedback current having the same frequency as the drive current but 180 degrees out of phase with the giant magnetoresistive signal~~.

34. (Original) An eddy current device as recited in claim 33, further comprising computer control of the amplitude, frequency, and phase angle of the source signals to the feedback and excitation coils.

35. (Original) An eddy current device as recited in claim 32, further comprising spatial Fourier filtering of the amplified low-pass filtered signal.

36. (Original) An eddy current device as recited in claim 35, further comprising:

windowing the filtered data amplitude into two segment arrays, each segment array having a width equal to one half the period of the flaw frequency, wherein the spacing between the two windows is set such that a full period separates the center position of the two segment arrays;

reversing the data in one of the arrays;

multiplying the reversed and nonreversed arrays;

calculating the average value of the array product; and

adding the average value to the device response amplitude at the point centered directly between the two windows.